United States
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Forest Service

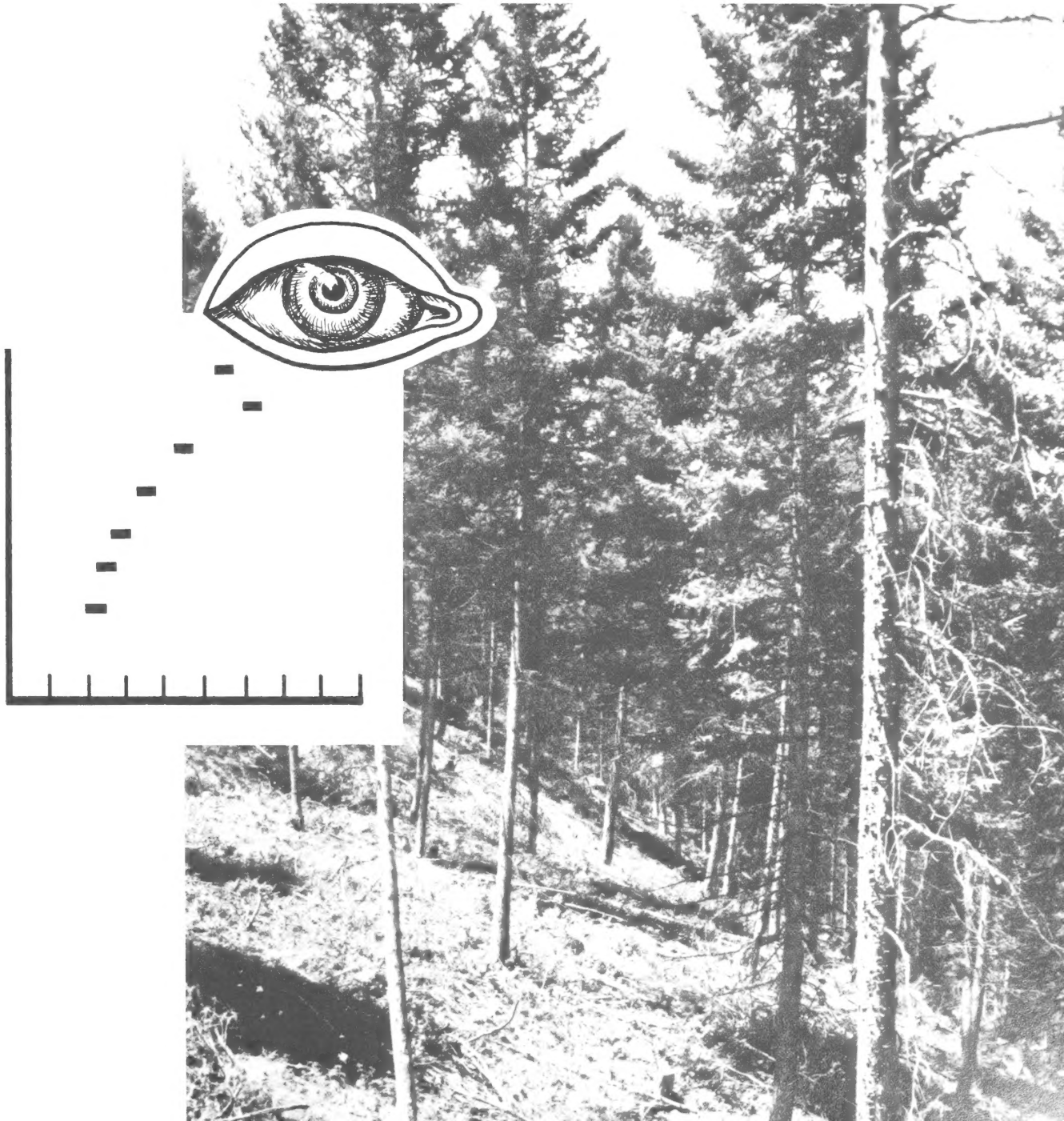
**Intermountain
Forest and Range
Experiment Station**

Research Paper
INT-262

June 1981

Visual Impacts of Forest Management Activities:
Findings on Public Preferences

Robert E. Benson
James R. Ullrich



THE AUTHORS

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RESEARCH SUMMARY

The visual appearance of various timber harvest and road construction alternatives was measured using the Scenic Beauty Estimation method. Panels of viewers rated color slides on a 0 to 9 scale of "dislike" versus "like." Numerous case studies have shown that the method gives consistent and reliable measures of viewer preferences. In general, partial harvesting is preferred to clearcutting, and the less logging debris, the higher the preference. In addition, less soil disturbance and more revegetation along the roads, the higher the preference.

These findings are not unexpected but they do provide a basis for comparing preference for one treatment relative to another, and they show how different treatments compare in their posttreatment response over time. Two study areas that were partially cut with logging residues subsequently removed were rated as being "liked" within 3 years of harvest, while clearcut areas with partially burned piles of logging slash were rated low even 15 years after harvest.

Rankings of different treatments were nearly identical among different viewers even though they included such diverse interest groups as the wood industry and outdoor recreation management students. Study areas included several forest types and a variety of harvest and road construction situations.

The findings can be used to estimate visual impacts in planning of activities and to compare the esthetic gains or losses from alternative practices.

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INTRODUCTION

A major concern of forest land managers is the visual impact that activities such as timber harvest, road building, and mining have on the forest landscape. Management of the visual resource is a regular part of planning on National Forests, and many other public and private forest land managers are increasing their efforts to protect and enhance this resource.

The Forest Residue and Harvesting Research Program at the Intermountain Station includes studies of the impact of harvest and roading activities on visual quality. Preliminary results were reported earlier (Schweitzer, Ullrich, and Benson 1976). This report updates earlier findings and presents highlights of more recent studies.

OBJECTIVES AND METHODS

The purpose of the present series of studies was to measure public response to various types of timber harvesting activities. Frequently, managers have several alternatives available which may differ in their visual impact. If the likes or dislikes of the public for these alternatives can be predicted, the manager has a basis for comparing the costs against esthetic benefits in planning.

There are some obvious problems in attempting to measure and compare visual quality. Many psychometric techniques have been used in attempting to measure viewers' responses (Arthur and Boster 1976). The technique used in these studies is the Scenic Beauty Estimation (SBE) Technique (Daniel and Boster 1976). This procedure consists of showing a series of randomly selected slides of an area to panels of viewers who make a numerical rating between 0 (dislike) and 9 (like). An SBE score and a mean rating (raw arithmetic mean) for each scene are developed from these ratings.

The SBE score is a sophisticated measure of viewers' response based on mathematical transformations that take into account the fact that some viewers use the rating scale differently than others. For homogenous groups of observers, the mean ratings and the SBE scores are usually closely related. To simplify the presentation, mean ratings are used in this report because this presents results in the same units of measurement as viewers rated the scenes. The SBE scores were used in analyzing the results while the mean ratings and critical differences presented refer to raw data. In all cases these data parallel the SBE values.

The statistical data on SBE's mean ratings, analyses of variance, and tests of significance are on file at the Forestry Sciences Laboratory, Missoula, Mont.

Scales such as the 0 to 9 scale used in this study are called categorical insofar as judgments are placed in a small number of categories represented by integer numbers. These scales are ordinal in that they indicate order. A scene given a certain numerical rating is preferred to a scene given a lower numerical rating. Ordinal scale ratings do not, however, indicate how much difference in preference is expressed by the two ratings. That is, while a rating of 4 indicates a preference over 3, and a 3 over a 2, 4 is not twice as preferred as 2. Furthermore, the difference between 4 and 3 need not be the same as between 3 and 2.

If these were interval scales, the difference in preference, say, between a 2 and 3 rating is the same as between a 3 and 4. The intervals are the same. It is then possible to compare scenes using conventional parametric statistical tests which are more powerful than nonparametric tests used with ordinal data.

There has been considerable debate as to whether or not parametric tests can be applied to categorical, ordinal data. (Anderson 1972). Specifically, parametric tests would be used to determine if ratings given to one scene are statistically significantly different from another scene (i.e., scenes are drawn from different populations). We have adopted this view in the studies reported here using mean ratings to determine if there are statistically significant differences between scenes.

Furthermore, we have elected to treat mean ratings as if they were constructed from an interval scale and by so doing compare mean ratings to show quantitative differences between scenes.

There is no "proof" that the rating scale used is an interval scale. The hazard in using an ordinal scale as if it were an interval scale is that it may erroneously overstate or understate the true intensity of likes or dislikes. The reader should, therefore, be aware that the mean values presented show quantitative differences in preferences *only* to the extent the assumption of an interval scale is accepted.

RESULTS

The scenic preferences reported here are from several individual studies of timber harvesting and roadbuilding. Usually several different panels have been used to replicate the tests from a given area. But since results presented correspond to raw means that have not been tested between panels, the reader is cautioned against making these comparisons; valid comparisons are limited to within-panel. The studies are grouped together under various topics to highlight different aspects of the studies.

In total, the results summarize the ratings of approximately 15 panels with an average of about 30 viewers per panel. Each viewer rated 140 to 200 slides, for a total of about 75,000 individual viewer-rating responses.

Undisturbed Forests: The "Baseline"

Often, when a timber harvest or similar activity is planned, the impact is assessed by comparing it to the undisturbed preharvest condition. This raises the question of how viewers rate different undisturbed "baseline" forest scenes.

Several panels were used in rating scenes from undisturbed forests. Only mature forests were used in this evaluation since this is where most harvesting is done. The views represented were what a person would see in the foreground either in walking or driving through the stand. Color slide pictures were taken in random directions at random points in the stand. About 25 slides were taken in each stand to allow a random sample to be shown to the viewer panel. Panels were shown slides of different scenes in random order, and they rated each slide on the 0 to 9 scale. The mean ratings of all slides in a given stand were then compiled, along with the SBE ratings, as described in the SBE technique.

The ratings given by panel viewers for different mature forest scenes are shown in figure 1, along with some typical photos of the scenes being rated. It should be recognized that the photos in figure 1, and in others that follow, are only typical of what the viewers rated. In the actual evaluation they rated five to ten slides of each forest condition, and the ratings shown are the mean ratings of all those slides for all judges. The ratings in figure 1 show the range in ratings given by different panels. Extensive repetition and testing indicates that the rankings of different scenes are nearly always the same between panels.

The rating of mature forest scenes was usually toward the "like" end of the scale, with some difference in mean ratings between stands of different species. These stands were somewhat open with little or no debris evident. Ratings, however, were significantly lower in a decadent lodgepole pine stand that had a large amount of down material, even though there had been no logging. The SBE method as used in these studies did not determine which elements of a scene contribute to likes or dislikes; however, the preference for open and natural looking conditions and a dislike for clutter and debris is borne out in studies by Arthur (1977) and Daniel and Schroeder (1980). Detailed summary of the mean ratings is given in table 1.

Table 1.--Mean ratings of mature forest stands

Species type	Viewer panel[1]				
	1	2	3	4	5
	Mean rating				
Larch	6.27	6.29	7.39	6.60	6.17
Douglas-fir	*	*	*	*	5.26
Grand fir	*	*	*	*	5.84
Lodgepole pine:					
meadow edge	6.22	6.15	6.56	6.92	5.68
mature stand	5.79	5.93	6.72	6.19	5.12
decadent stand	4.30	4.72	4.58	4.98	4.22
(Critical diff.)[2]	(.60)	(.60)	(.60)	(.60)	(.45)

[1]Panel numbers refer to following:
1. University of Montana psychology students, 1973;
2. University of Michigan psychology students, 1973;
3. Montana public school teachers, 1973;
4. USDA Forest Service researchers, 1973;
5. University of Montana forestry students, 1980.

[2]Differences between means that exceed this are significant at the 0.95 level.

*This panel did not evaluate this scene.

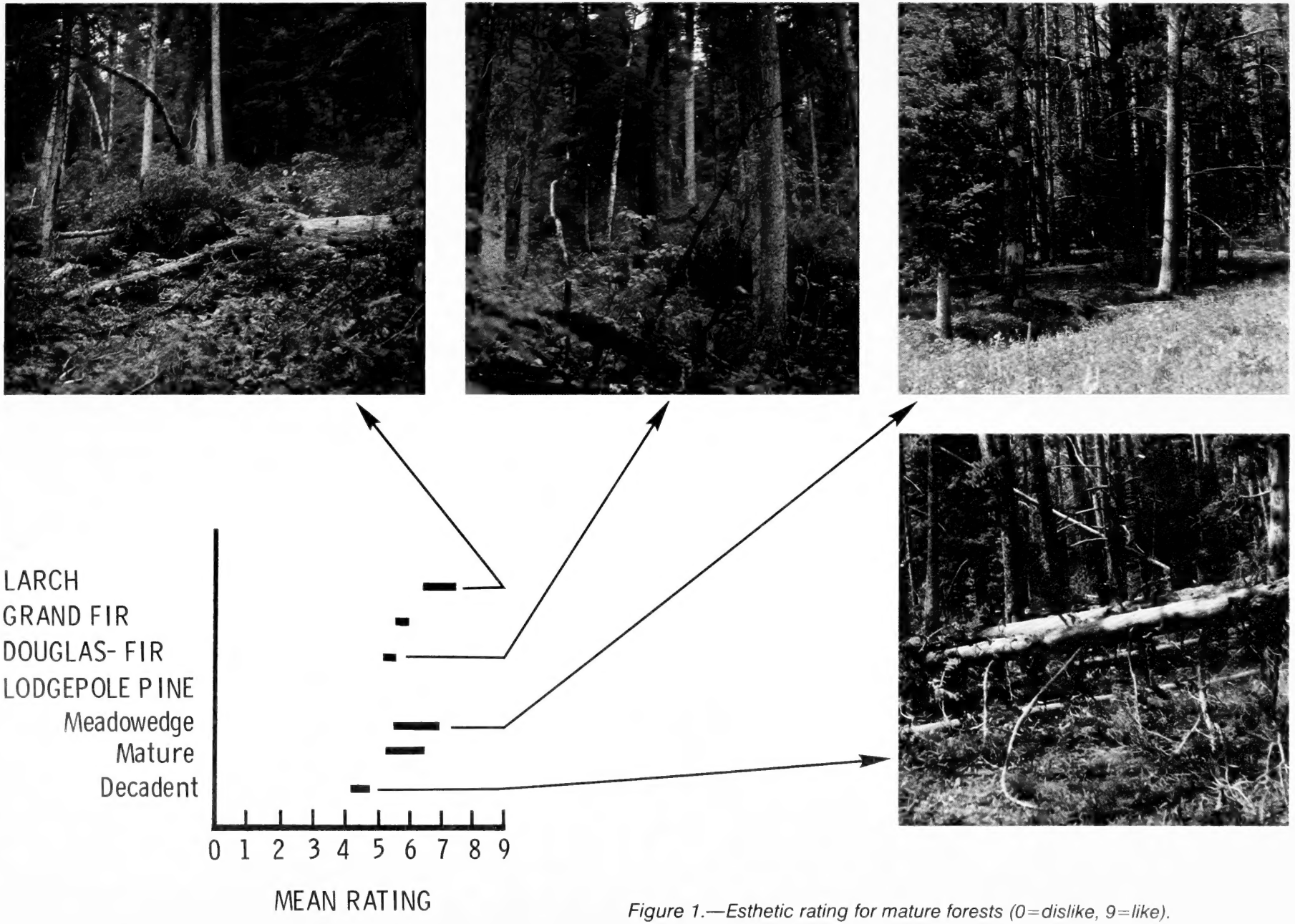

Figure 1.—Esthetic rating for mature forests (0=dislike, 9=like).

Harvested Areas

A number of harvesting sites were studied to compare the visual impact of alternative harvesting methods used, and to determine how rapidly areas receiving different treatments recover over time.

One lodgepole pine stand in the Teton National Forest (now Bridger-Teton) was clearcut in 1971 and four methods were used in treating residues: (1) near-complete removal of residues from the site; (2) residues chipped and spread back over the ground; (3) residues tractor piled into windows and burned; (4) residues broadcast burned (that is, without piling).

The panel ratings of these treatments of the first years after harvest are shown in figure 2. Treatments were rated low by all panels the first year but piled/burned was rated higher in year 5. One panel rated all treatments in later years. Their ratings suggest only small differences among treatments, with residue removed rated higher. This may have practical significance to the land manager since there is a growing trend toward utilizing more of the residue fiber from a site which results in near-complete residue cleanup. As to the other treatments, it again appears that debris is a factor in detracting from a site. Detailed summary of this study is table 2.

Table 2.--Mean ratings of lodgepole pine harvest areas, Teton National Forest, Wyoming

Treatment	Viewer panel[1]				
	1	2	3	4	5
	Mean rating				
Meadow-forest edge	6.22	6.15	6.56	6.92	7.43
Mature, uncut	5.79	5.93	6.72	6.19	5.75
Residues removed:					
Year 1	1.39	1.52	1.04	2.15	3.09
Year 5	*	*	*	*	3.61
Residues chipped and spread on site:					
Year 1	2.13	2.97	2.33	2.44	2.71
Year 5	*	*	*	*	2.25
Residues piled/burned:					
Year 1	1.19	1.46	1.07	1.37	2.40
Year 4	*	*	*	*	2.50
Year 5	2.22	2.65	1.99	2.80	2.96
Residues broadcast burn:					
Year 4	*	*	*	*	2.47
(Critical diff.)[2]	(.60)	(.60)	(.60)	(.60)	(.86)

[1]Panel numbers refer to:
1. University of Montana psychology students, 1973;
2. University of Michigan psychology students, 1973;
3. Montana public school teachers, 1973;
4. USDA Forest Service researchers, 1973;
5. University of Montana psychology students, 1977.

*This panel did not evaluate this treatment.

[2]Differences between means that exceed this are significant at the 0.95 level.

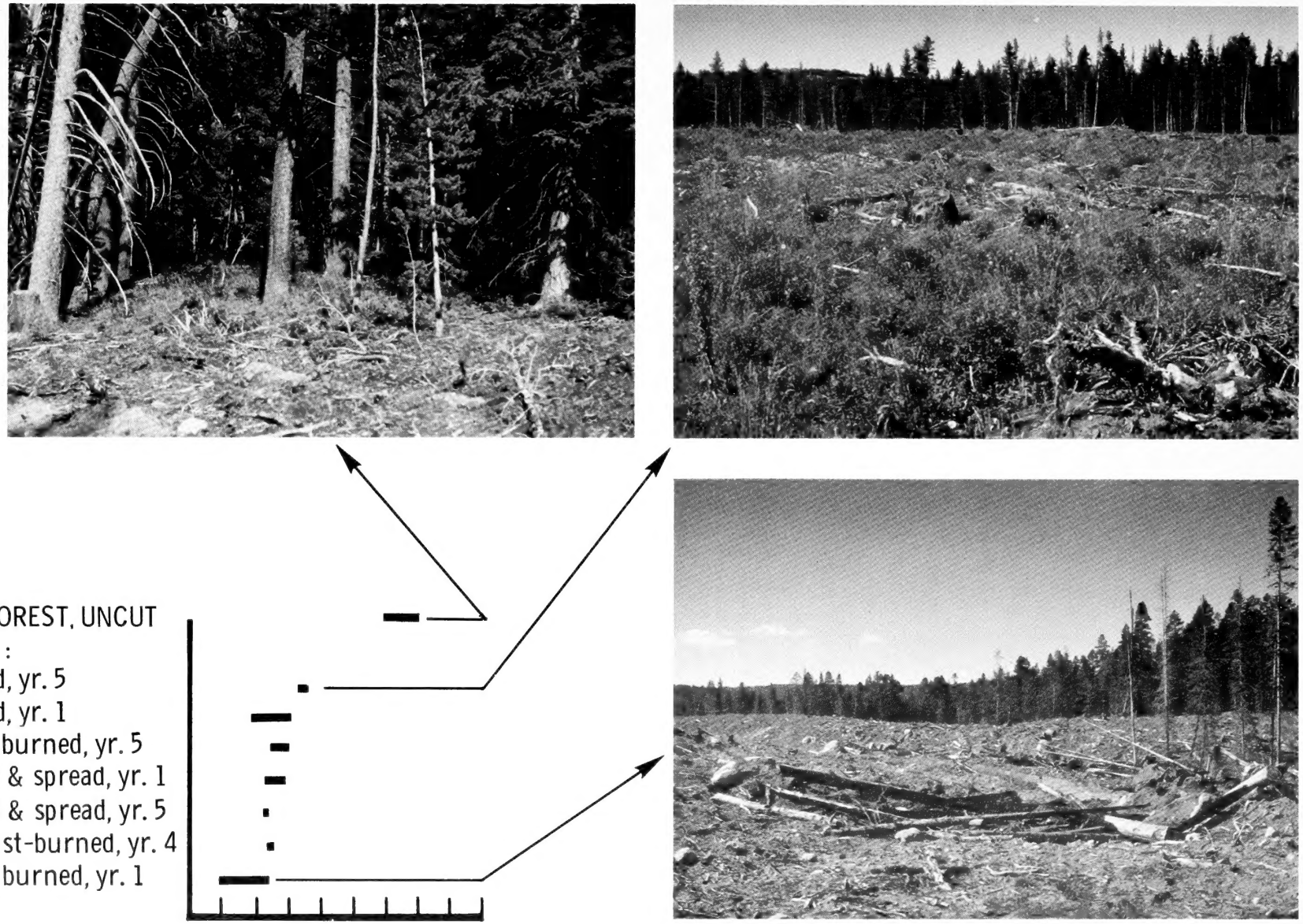

Figure 2.—Esthetic rating for alternative harvest and postharvest treatments, mature lodgepole pine clearcuts.

Similar results were noted in an old growth Douglas-fir forest (Coram Experimental Forest, Montana) where near-complete removal of residues, broadcast burning, and protection of an advanced understory were used in clearcut and partial cut (shelterwood) units. There were differences in ratings that have both practical and statistical significance:

(1) The mature uncut stand was preferred to every harvested area, particularly to the first years after harvest.

(2) Shelterwood harvest was usually preferred to clearcuts, regardless of residue treatment.

(3) Residue removed treatment, which included cutting and removing the understory, was rated about the same as protecting the understory (within a given cutting method).

(4) Ratings increased in the years after harvest for all treatments, although in some cases the year-to-year changes were not significantly different.

As in the lodgepole pine study reported above, disturbance and debris appeared to influence ratings, particularly in the first year. By the second and third years undergrowth vegetation had begun to cover soil disturbance and debris, and ratings were higher. The ratings in shelterwood residue removed were higher than clearcut residue removed, and also higher than any residue burned treatment, probably because undergrowth still did not cover the partially burned larger residue material.

Ratings are illustrated in figure 3, and detailed data presented in table 3.

Table 3.--Mean ratings of timber harvest by skyline logging in Douglas-fir/larch, Coram Experimental Forest

Treatment	Viewer Panel[1]	
	1	2
	Mean rating	
UNCUT STAND	7.59	7.02
SHELTERWOOD		
Residue burned:	2.96	*
First year	3.43	4.06
Second year		
Residue removed:		
First year	3.92	*
Second year	6.07	*
Third year	6.54	5.94
Protect understory	5.46	5.74
CLEARCUT		
Residue burned:	1.29	2.74
First year	3.63	2.76
Second year		
Residue removed:		
Second year	3.27	3.09
Third year	5.04	4.92
Protect understory		4.97
(Critical diff.)[2]	(1.08)	(.97)

[1]Panel 1, University of Montana psychology students, 1976; Panel 2, University of Montana forestry students, 1976.

[2]Differences between means that exceed this are significant at the 0.95 level.

*This panel did not evaluate the scene.

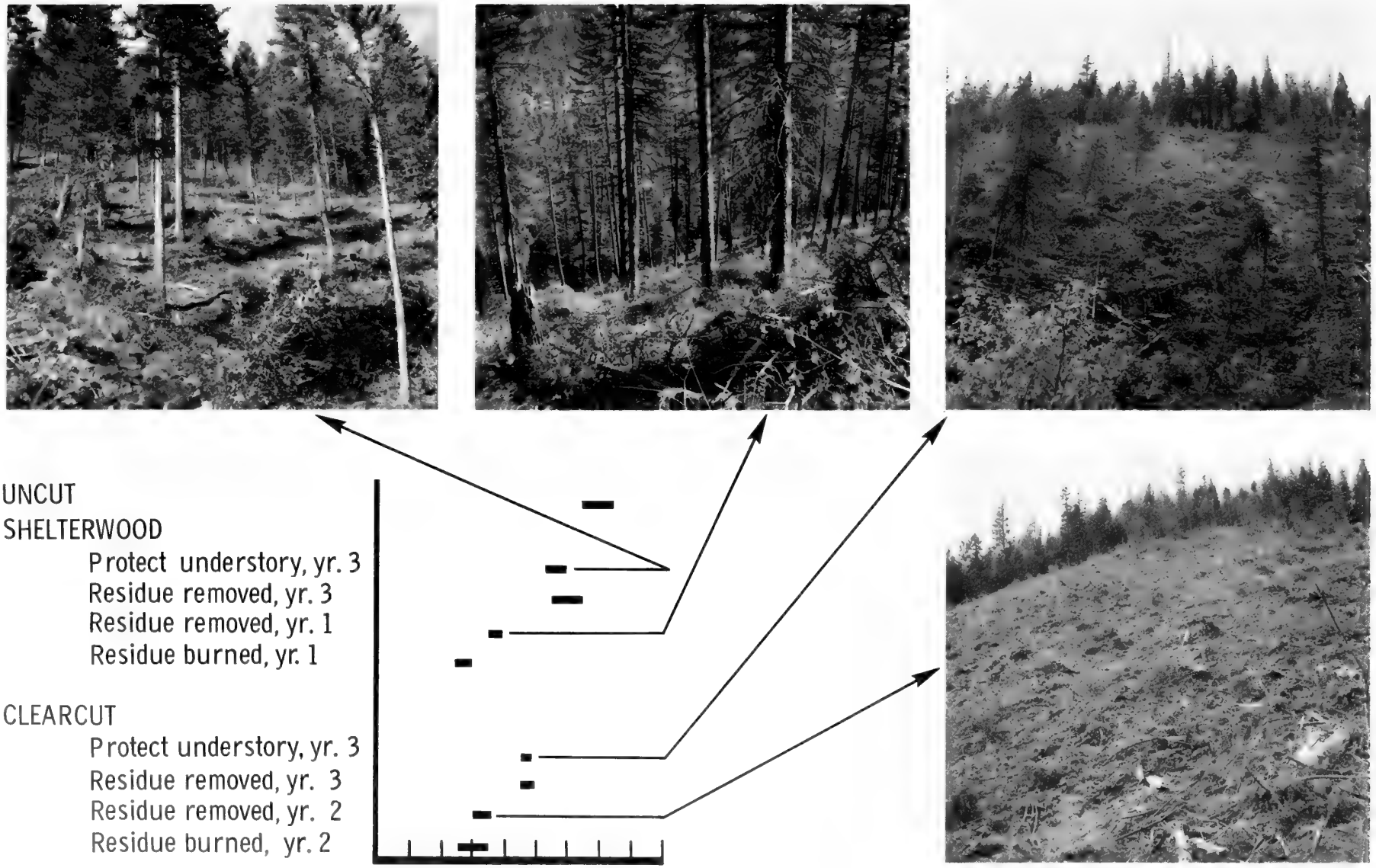

Figure 3.—Esthetic rating for alternative harvest and postharvest treatments, mature Douglas-fir/larch.

Winter versus Summer

One area studied is used heavily for cross-country skiing, and an evaluation was made of both summer and winter ratings. A mixed-age stand of Douglas-fir and larch was harvested using clearcut, overstory removal, and understory removal. Near-complete removal of residue was done on portions of the cutting units, and lopping and scattering the residues on another portion. The residue treatments were rated about the same with snow cover, but in summer the near complete removal treatment was rated higher in the understory cut unit (fig. 4).

Winter ratings were nearly the same for all units, probably because snow covered most of the debris and disturbance. In the understory removal treatment, however, the summer rating was high for residues removed. This was probably because there was so little residue remaining in this unit that the first year's growth of small vegetation covered the debris, whereas in the overstory and clearcut units the disturbance was still quite visible the first summer.

Detailed data on these units and adjacent uncut stands are summarized in table 4.

Table 4.--Mean ratings of Douglas-fir/larch tractor logging, Lubrecht Experimental Forest, winter and summer

Treatment	Viewer panel[1]		
	1	2	3
	Mean rating		
UNCUT	5.12	5.41	*
WINTER, first year			
Understory removed	4.93	5.01	*
Overstory removed	4.44	4.63	*
Clearcut	4.10	4.07	*
SUMMER, first year			
Understory cut:			
residue removed	*	*	6.09
residue remain	*	*	4.42
Overstory cut:			
residue removed	*	*	3.48
residue remaining	*	*	2.87
Clearcut:			
residue removed	*	*	2.39
residue remain	*	*	2.22
(Critical diff.)[2]	(.63)	(.60)	(.84)

Panel 1 University of Montana psychology students, 1978.
Panel 2 University of Montana forestry students, 1978.
Panel 3 University of Montana psychology students, 1979
[2] Differences between means that exceed this are significant at the 0.95 level.
*This panel did not evaluate this treatment

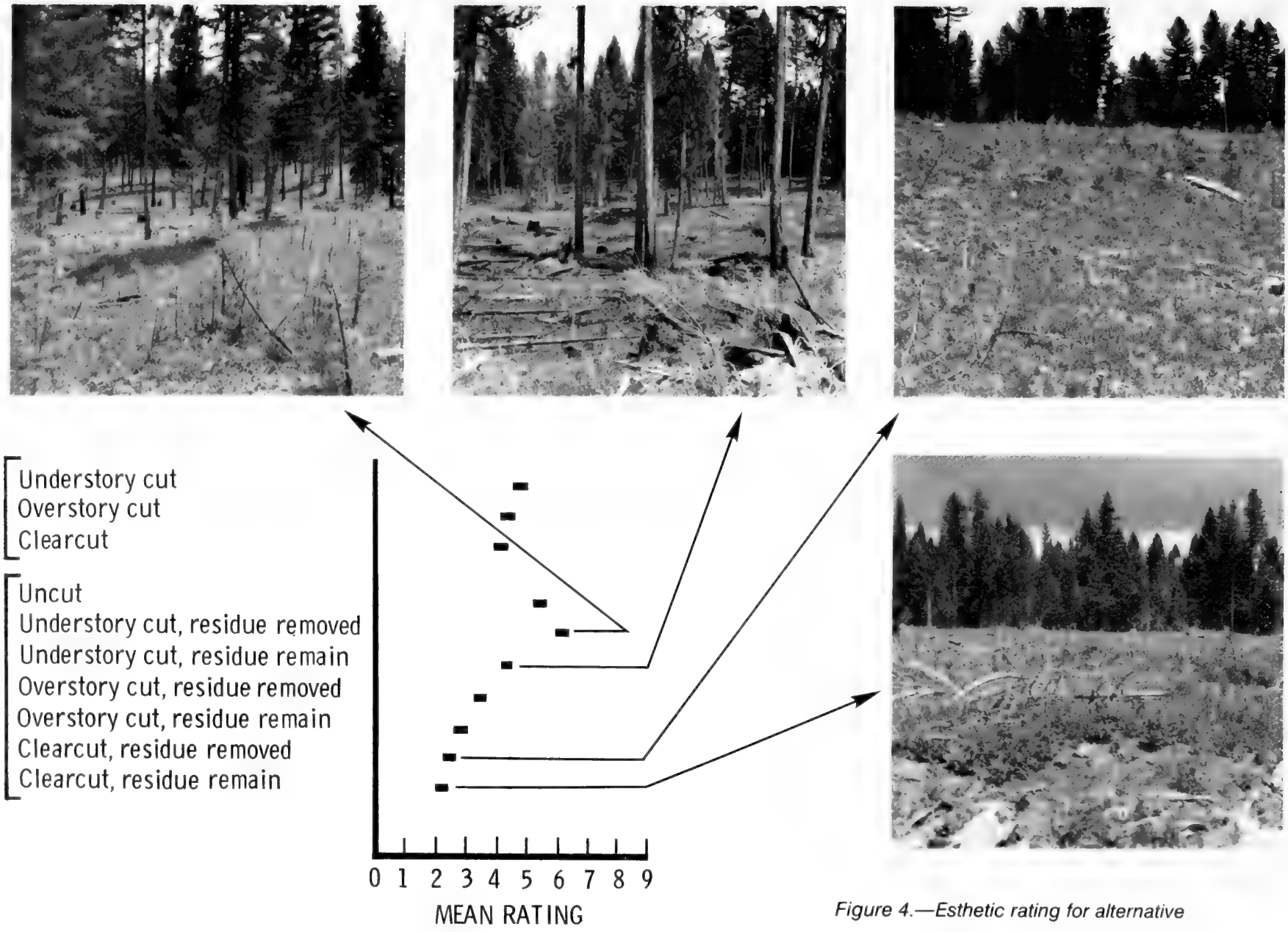

Figure 4.—Esthetic rating for alternative harvest treatment, mature Douglas-fir.

Changes Over Time After Harvest in Clearcuts

The above studies apparently show that viewers' ratings of post-harvest activities are related to the length of time the area has for recovering as well as to different treatments. In both the Teton and Coram study areas cited above an improvement of viewers' rating was often noted in later years.

We hypothesized that changes in viewer ratings after harvest are related to growth in vegetation, since this is the principal visual change on the site. To evaluate the effect of vegetation development, we selected and photographed a series of sites at different stages of succession following harvest. Two forest types were included; lodgepole pine and Douglas-fir/larch. The stages we included were: first year after treatment; several years later when herbs, grass, shrubs, etc., had developed so as to give a "green" appearance; later, when young trees began to be distinguishable (usually 5 to 15 years); later when the young stand is large enough to be considered an established vigorous forest (about 25 to 50 years), and finally when the stand has reached maturity. To assure reasonable comparison we selected only sites that had been clearcut and burned (except for the mature stands where origin could not be identified, but probably is not important at that age).

The ratings by panel 5, shown in figure 5, typified the trend in ratings we had expected. Both the Douglas-fir and larch (DF/L) and the lodgepole pine (LPP) harvest areas were rated low initially. About 10 years after harvest the DF/L had reached a point on the "like" portion of the scale, probably because these stands are on moist sites that "green up" quickly (undergrowth is lush) and trees begin to grow rapidly. LPP took longer to reach this point reflecting the generally sparser vegetation and slower tree growth. When stands had reached heights of about 25 to 75 feet and crowns were green and vigorous, ratings were the highest.

In mature stands aged 150 years or more, ratings were lower. We can speculate that this is due to more dead material and debris, and also that the mature stands with a high dense canopy are darker and more enclosed than in younger stands. The exact age or condition at which ratings begin to decline could not be determined from this preliminary study. Such information might be useful in managing such areas as campgrounds, recreation areas, and nature trail areas. Detailed ratings of this study are in table 5.

Table 5.--Mean ratings of lodgepole pine and Douglas-fir/larch forests over time following clearcut harvest and slash burning

Type of forest and years after harvest	Viewer panel[1]				
	1	2	3	4	5
	Mean rating				
Douglas-fir/larch					
1-2	2.76	*	*		2.22
5	3.66	4.80	3.23	3.96	*
10	*	*	*		5.15
18	6.12	6.21	6.51	5.56	*
23	6.04	6.63	7.23	5.89	*
30-50	*	*	*	*	6.81
Mature (150)	6.27	6.29	7.39	6.60	5.98
Lodgepole pine					
1-2	1.19	1.46	1.07	1.37	*
4-5	2.22	2.65	1.99	2.80	2.37
15-20	*	*	*	*	5.51
25.50	*	*	*	*	7.33
Mature (150)	4.30	4.70	4.58	4.98	5.50
(Critical diff.)[2]	(.60)	(.60)	(.60)	(.60)	(.84)

[1]Panel numbers refer to following.
1 University of Montana psychology students, 1973;
2 University of Michigan psychology students, 1973;
3 Montana public school teachers, 1973;
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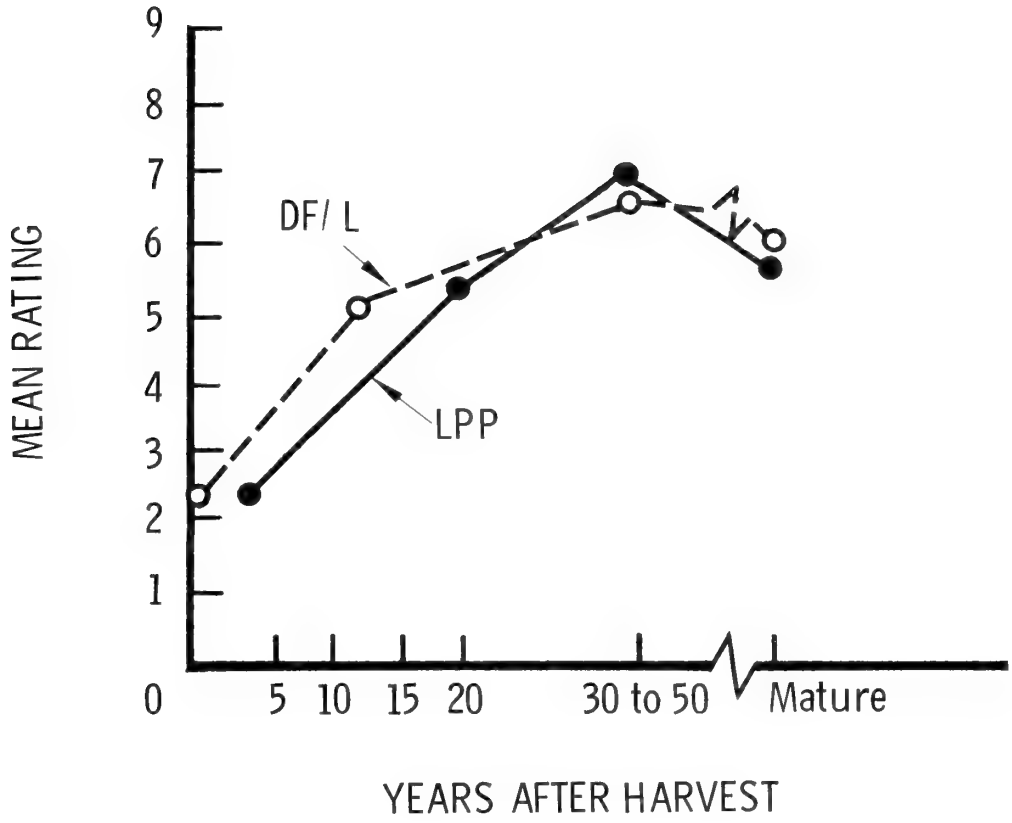

Figure 5—Esthetic rating over time following clear-cutting.

Roads and Trails

Much of the visitors' view of the forest landscape is seen from a car along a road, or from a trail. Studies by Schroeder and Daniel[1] show the SBE method can be used to evaluate viewers' perceptions of roads.

In a study of the Coram Site in Montana reported earlier, we found that people appeared to prefer older roads with established vegetation along side and that their dislike for new construction increased with the amount of bare earth and rock exposed. (See Schweitzer, Ullrich, and Benson 1976.) We further explored these observations in two other areas: in a grand fir forest area (Horse Creek, Nezperce National Forest, Idaho) where new roads and reconstruction of existing roads are planned; and in Silver Creek (Boise National Forest, Idaho) where reconstruction is planned for an existing road on fairly steep, erodible granitic soil. Our study compares uroaded conditions, existing road conditions, and in the future will include postconstruction evaluation.

Figure 6 and table 6 show that the highest ratings were in the grand fir forest where an existing road crossed small streams and springs. The existing road, where well vegetated, seemed to be slightly preferred to even the unroaded forest as seen along the location trail which had been put in prior to constructing new roads. Wherever there were signs of disturbance to soil or vegetation the ratings were lower.

The lowest rating was given to an existing road on the dry erodible Douglas-fir hillside. This is an old, poorly located road on the Boise National Froest that has eroded in places, exposing bright soil and rock in sharp contrast to the surrounding forest.

[1]Schroeder, Herbert W., and Terry C. Daniel [In press] Predicting the scenic quality of forest road corridors. *In* "Environment and Behavior."

This section of road is poorer than most in the area, but was included to provide an estimate of the esthetic consequences of poor roads and deterioration. We expect that in this area a trail or modest, well constructed road would have a fairly high rating because the forest is more open and has more visual variety than the grand fir forest.

In figure 6, there was not much difference in ratings except where there was obvious soil disturbance. But from a practical standpoint, their ranking is consistent with the idea that things looking orderly and natural are preferred to evidence of disturbance and deterioration. The detailed ratings are summarzied in table 6.

Table 6.--Mean ratings of roads and trails

Area and condition	Viewer panel[1]
Horse Creek, grand fir type, Nezperce National Forest	
Existing road, typical	6.33
Existing road at stream crossing and openings	6.55
Existing road with cut bank	5.60
Trail with some vegetation cut	5.28
Trail with soil distrubed	3.61
Silver Creek, Douglas-fir and ponderosa pine, Boise National Forest	
Old, poor road with sidecut erosion	2.85
(Critical diff.)[2]	(1.08)

[1]University of Montana psychology students. Replication of this evaluation planned in connection with post-road construction study. See "Horse Creek administrative - research study site, Nezperce National Forest. Study Plan No. 4 (Esthetic evaluation). 1977," on file at Forestry Sciences Laboratory, Missoula, and Nezperce National Forest supervisor's office and Selway Ranger District.

[2]Differences between means that exceed this are significant at the 0.95 level.

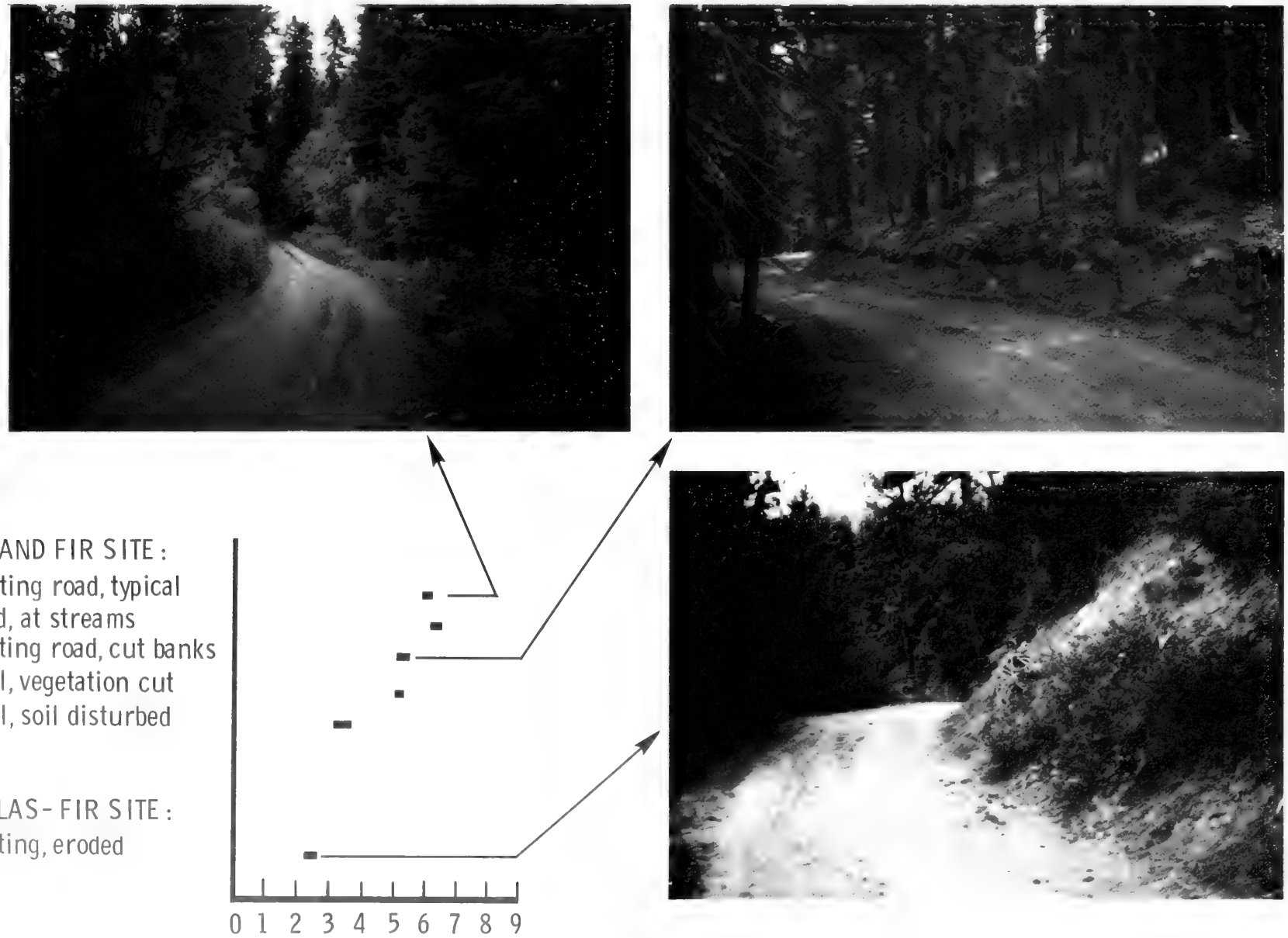

Figure 6.—Esthetic rating of different road and trail conditions.

CONCLUSIONS AND COMMENTS

The above studies represent an effort to measure the visual impact of various harvesting and roading activities using primarily one technique—the Scenic Beauty Estimation Method—as a basis for quantifying viewers' ratings of visual quality. Any attempts to quantify something as elusive as "scenic beauty," or more specifically the *perception* of scenic beauty by many individual viewers cannot be precise, and the SBE method like any other has inherent limitations and shortcomings.

Nevertheless, the case studies here have provided a good insight to public likes and dislikes for different activities affecting the landscape. The SBE method's use of slides and panel viewers is a convenient way of obtaining public opinion, at a fraction of the cost of taking people out on the site.

Specifically, these studies indicate that:

1. In forest landscapes people like natural and orderly scenes as opposed to disturbed, disorderly ones.

2. Revegetation and tree growth following disturbance improves viewer's ratings over time.

3. The ability to quantify viewers' ratings of different treatments and changes in ratings over time following treatments gives managers a tool for comparing how much visual benefit is gained using one treatment versus another.

At the same time it should be recognized that many other techniques can be used to measure viewers' ratings of scenic beauty and to extend the findings reported here. For example, techniques have been developed to identify what features in a given scene are liked or disliked, and what impact extraneous features have on the perception of the scene under view (Swanson 1976; Touzeau 1976).

Throughout these studies questions were asked as to how ratings might be affected if a group were given an interpretive presentation on timber harvesting, or how different groups, such as environmentalists, differ from, say, loggers in their ratings of harvested areas. These are highly relevant questions to land managers, but were beyond the scope of these studies. We would note, however, that although the viewer panels represented a wide variety of interests, from school teachers to forestry students to timber industry representatives, scenes were ranked in the same order of relative like or dislike in virtually every evaluation, regardless of the group. Very similar results were reported by Daniel and Boster (1976) in a comparison of 26 different groups.

In light of these results, the case studies reported here can be considered as indicators of the public's reaction to different harvesting and roading activities.

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KEYWORDS: esthetics, landscape management, visual quality, logging, residues